

FORM PTO-1390 (REV. 11-2000)		U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER HOM 100	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				U S APPLICATION NO (If known, see 37 CFR 1.5) <div style="font-size: 24pt; font-weight: bold;">09/869487</div>	
INTERNATIONAL APPLICATION NO. PCT/EP99/10394		INTERNATIONAL FILING DATE 27 December 1999 (27.12.99)		PRIORITY DATE CLAIMED 31 December 1998 (31.12.98)	
TITLE OF INVENTION GEOREFERENCED MONITORING SYSTEM					
APPLICANT(S) FOR DO/EO/US Klaus Homann and Burkhard Katzenbach					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below. 4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). <ol style="list-style-type: none"> a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). 					
Items 11 to 20 below concern document(s) or information included:					
<ol style="list-style-type: none"> 11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 15. <input type="checkbox"/> A substitute specification. 16. <input type="checkbox"/> A change of power of attorney and/or address letter. 17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825. 18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 20. <input checked="" type="checkbox"/> Other items or information: <ol style="list-style-type: none"> 1. Additional Priority Date Claimed: February 25, 1999 (25.02.99) 2. Also enclosed is Form PCT/IB/308. 					
EXPRESS MAIL NO. EL 845496958					

U.S. PATENT APPLICATION NO. (if known) 09/869487		INTERNATIONAL APPLICATION NO. PCT/EP99/10394		ATTORNEY'S DOCKET NUMBER HOM 100	
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21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY	
				\$ 860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	
Total claims	10 - 20 =	0	x \$18.00	\$ 0.00	
Independent claims	2 - 3 =	0	x \$80.00	\$ 0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ \$270.00	
TOTAL OF ABOVE CALCULATIONS =				\$ 860.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$	
SUBTOTAL =				\$	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$	
TOTAL FEES ENCLOSED =				\$ 860.00	
				Amount to be refunded:	\$
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a. ☒ A check in the amount of \$ 860.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees.
 A duplicate copy of this sheet is enclosed.


c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any
 overpayment to Deposit Account No. 50/1039. A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card
 information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR
 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.**

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09/869487
JC18 Rec'd PCT/PTO 2 8 JUN 2001

PATENT

Attorney Docket No. HOM 100

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
Klaus Homann and
Burkhard Katzenbach

International Application No.:
PCT/EP99/10394

International Application Filing Date:
December 27, 1999

Priority Date: December 31, 1998
and February 25, 1999

For: GEOREFERENCED MONITORING SYSTEM

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) "Express Mail" Mailing Label No. EL 845496958
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) Signature Ruben M. Gomez

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please enter this Preliminary Amendment prior to examination
and prior to calculating the filing fee.

IN THE CLAIMS:

Please amend Claims 3-6 and 8 as follows:

3 (Amended). The device as claimed in claim 1,
characterized by a computer unit (18) with a geographic
information and documentation system.

4 (Amended). The mobile measuring device as claimed in
claim 1, characterized by electronic documentation of the
measured results.

5 (Amended). The mobile measuring device as claimed in claim 1, characterized by acoustic and/or optical guidance of the operator, using calculated navigation data.


6 (Amended). The mobile measuring apparatus as claimed in claim 1, characterized by a supporting/measuring wheel (6).

8 (Amended). The device as claimed in claim 1, characterized in that the satellite position measuring system is coupled with sensors on the measuring wheel (6) and/or in the measuring electronics (12), which extrapolate the position information by generating a distance vector in the computer unit (18).

REMARKS

This is a Preliminary Amendment to the above-identified patent application. This Amendment is made to remove the multiple dependencies in claims 3-6 and 8. A clean version of the claims, as amended, is set forth above and a marked-up version of the claims showing the above changes is attached hereto, in accordance with 37 CFR 1.121.

Respectfully submitted,



Gary W. McFarron
Attorney of Record
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(312)236-8500

VERSION WITH MARKINGS TO SHOW CHANGES MADE

3 (Amended). The device as claimed in claim 1 [or 2], characterized by a computer unit (18) with a geographic information and documentation system.

4 (Amended). The mobile measuring device as claimed in [one or more of the preceding claims] claim 1, characterized by electronic documentation of the measured results.

5 (Amended). The mobile measuring device as claimed in [one or more of the preceding claims] claim 1, characterized by acoustic and/or optical guidance of the operator, using calculated navigation data.

6 (Amended). The mobile measuring apparatus as claimed in [one or more of the preceding claims] claim 1, characterized by a supporting/measuring wheel (6).

8 (Amended). The device as claimed in [one or more of the preceding claims] claim 1, characterized in that the satellite position measuring system is coupled with sensors on the measuring wheel (6) and/or in the measuring electronics (12), which extrapolate the position information by generating a distance vector in the computer unit (18).

3/PRTS

WO 00/40891

09/869487
JC18 Rec'd PCT/PTO 28 JUN 2001
PCT/EP99/10394

Georeferenced Testing System

- 5 The invention relates to a system for monitoring supply lines, such as gas lines laid underground.

In the prior art, gas supply lines are monitored with the aid of a measuring group, comprising a path finder and a tracer. Such measuring groups carry out checks on the gas supply lines for their tightness at regular intervals, on account of the statutory monitoring obligation of the power supply companies.

- 15 The actual activity of such a measuring group consists in patrolling the gas supply lines and determining a possible escape of supply gas by using a gas tracing instrument. The course of gas supply lines, generally laid underground, is naturally not readily detectable, so that a pathfinder, as a part of the measuring group, is responsible for the proper following of the measuring path. The gas tracing instrument is guided by the "tracer" in accordance with the navigation instructions from the pathfinder.

- 25 This procedure is relatively complicated, since the pathfinder, in the initial part of the monitoring operation, has to draw up extracts from maps and work out a suitable tracing path. During the measuring operation, the pathfinder is normally responsible for monitoring the completeness of the measurement and recording the measured results.

- 35 In this case, the line sections inspected are marked in writing with the points of note relevant to the operation of the line system. The recordings are used with respect to the responsible inspecting authorities as proof of the monitoring obligation placed by statute on the power supply company.

In the procedure described above, the use of at least two persons is absolutely necessary.

5 Furthermore, the reliability of the measurement depends both on the care of the pathfinder and the care of the tracer. For example, it is conceivable for the pathfinder, in the event of an inaccurate procedure, to deviate from the measurement path necessary for the
10 verification of a gas escape and, as a result, a gas escape location will be overlooked. In addition, there is the risk of information losses arising from incomplete or faulty recording of the monitoring results.

15 The invention is, then, based on the object of providing a monitoring system which avoids the aforementioned disadvantages and permits reliable monitoring.

20 The problem is solved by the independent claim 1. Advantageous embodiments are reproduced in the subclaims.

25 In detail, the problem of the invention is solved by a mobile measuring device being combined with an electronic guidance system which preferably has recourse to existing satellite-assisted navigation system, in conjunction with a geographical information
30 system for generating the navigation information.

Particular preference is given to a combination of a mobile measuring device with navigation system with automatic documentation of the measured results and/or
35 acoustic or optical guidance of the operator by using the navigation data determined.

With the aid of the measuring device according to the invention, the monitoring operation can be carried out

by a single person. By using the computer-controlled navigation and documentation, the monitoring becomes largely independent of the reliability of the operator.

- 5 A particular advantage consists in the fact that the safety of the operator during the monitoring operation is increased considerably. Because of the actual course of the gas line, it is often necessary to inspect locations at risk from traffic during a monitoring
10 operation. The fact that substantial monitoring functions are performed by the mobile device permits the operator to direct his concentration to avoiding hazards during the inspection. In particular if an acoustic guidance system is used, the concentration
15 potential of the operator is largely free and is therefore available, for example, for avoiding hazards.

- A recording of the track of the path patrolled, as implemented by one embodiment of the measuring device,
20 provides the advantage of permitting exact local allocation of the measured values.

- In the following text, the invention will be described in detail using an exemplary embodiment illustrated in
25 the drawing, in which:

Fig. 1 shows a mobile measuring device according to the invention;

- 30 Fig. 2 shows a flow diagram of a monitoring inspection with the aid of the measuring device according to the invention;

- Fig. 3 shows a flow diagram of a first-time
35 determination of a track with the aid of the measuring device according to the invention.

The mobile measuring device 1 comprises a frame 2 having rollers 4, 6 and a guide arm 8 with a guide

handle 10. Arranged on the frame are measuring electronics 12 with satellite and dead-reckoning navigation devices, gas testing devices and a power supply. In addition, the frame has an antenna 14 to
5 receive satellite and correction data, and also a table 16 arranged in the area of the guide arm 8 and having a computing unit 18.

The frame is equipped with three running wheels, the
10 central running wheel 6 being used at the same time as a measuring wheel for the distance and being connected to the computing unit.

The computer is arranged on the table in such a way
15 that the operator, when guiding the mobile measuring device 1 at the handle 10 can read data displayed on the monitor 20 of the computer 18 during the inspection. The computer 18 also has a device for transmitting an acoustic signal to the operator.

20 For the purpose of determining position with the aid of the satellite navigation device 12 and the antenna 14, recourse is initially made to existing satellite navigation systems, such as GPS (USA) and Glonass
25 (Russia). A differential method is added to the aforementioned systems in order to increase the accuracy of the location determination. For this purpose, recourse can be made to correction methods which are already available, such as the SAPOS-HEPS
30 real-time positioning system of the German land survey offices or a known reference station of the power supply company or line operator. If the accuracy of the pure satellite navigation position is adequate, the system may also be operated without reference points.

35 In order to bridge brief outages during the reception of the satellite signals, the use of an additional dead-reckoning navigation system is advantageous. With the latter system, the last position determined by the

satellite system is extrapolated in terms of magnitude and direction by means of a distance vector until the satellite system supplies reliable data again.

- 5 The magnitude of the distance vector can be recorded, for example, by means of sensors in the measuring wheel
6. An indirect distance measurement can be achieved with the aid of speed sensors, by means of simple integration of the measured signal. A further indirect
10 possibility for measuring the distance consists in the double integration of the measured signal from an acceleration transmitter.

- The direction of the distance vector can be obtained
15 directly via an electronic compass or indirectly via an orthogonal pair of speed sensors. In addition, an inertia measuring system, for example in the form of a gyroscope or a two-axis orthogonal acceleration sensor, can be used to record the direction.

- 20 For the purpose of navigating the gas tracing instrument, use is preferably made of a geographic information system which is matched to the actual conditions of the area being monitored. It permits the
25 position information to be linked to the topographic information about the area being monitored. Initialization of the position measuring system is needed as a basis for this linking. For this purpose, use may be made of correction data from external
30 providers or correction data determined with the aid of dedicated stations at points whose coordinates are known. Also suitable is the determination of correction data by means of the operation of reference stations arranged in any desired way in the environment of such
35 points. The coordinates of the reference station are then determined by means of measurements with reference to at least one point whose coordinates are known.

The aforementioned initialization methods supply positioning coordinates in a reference system which is defined mathematically uniquely, such as WGS 84, which may be converted into real topographical information via appropriate transformation formulations.

The topographical information needed for navigation can be derived from existing network information systems from the power supply companies and, before the beginning of the inspection, can be transmitted to the computer unit 18 for the area to be examined.

The control path to be patrolled does not have to agree with the actual course of the supply lines. This is particularly the case in gas lines which are laid under sealed surfaces, since an escape of gas can be measured only in the edge regions of the sealed surface.

After being input into the computer unit 18, specialist information of this type is balanced with the positioning and distance data and taken into account in the guidance of the operator by means of the measuring device according to the invention. This can be carried out, for example, by means of integration of a digital track into the system. The track may be derived from available data and knowledge and entered into the computer unit 18.

A particular advantage of the measuring device according to the invention is that it permits automatic track recordings. The track, for example recorded within the context of a first inspection, can be used for all subsequent measurements.

Fig. 2 illustrates a flow diagram of the inspection over a gas line using the device according to the invention, while Fig. 3 illustrates a flow diagram of a recording of a digital track in the course of the first inspection.

In the procedure illustrated in Fig. 2, the operator is guided along the track predefined by the computer. In the process, the computer takes into account a tolerance band to the left and right of the desired path, and if this path is left, this is pointed out, and the operator, if this is intended, must react with an input of the reason for leaving the desired path. This reason is in turn processed in the documentation system of the computer unit and may be available during the next inspection.

In the event of an increased gas concentration being determined by the gas tracing instrument, the operator is given specific, standardized instructions in order to ensure reproducible documentation of the gas escape.

It is particularly advantageous to use a cable-free earpiece/microphone combination for the communication between the operator and computer unit, in addition to the display, loud speaker and keyboard. By means of these measures, the concentration of the operator is largely released for other tasks.

Overall, the invention therefore permits secure line monitoring with a low outlay on personnel.

Patent Claims:

1. A mobile measuring device for monitoring leaks on
gas lines, characterized by an electronic
5 navigation system.
2. The device as claimed in claim 1, characterized by
a satellite position measuring system.
- 10 3. The device as claimed in claim 1 or 2,
characterized by a computer unit (18) with a
geographic information and documentation system.
- 15 4. The mobile measuring device as claimed in one or
more of the preceding claims, characterized by
electronic documentation of the measured results.
- 20 5. The mobile measuring device as claimed in one or
more of the preceding claims, characterized by
acoustic and/or optical guidance of the operator,
using calculated navigation data.
- 25 6. The mobile measuring apparatus as claimed in one
or more of the preceding claims, characterized by
a supporting/measuring wheel (6).
- 30 7. The mobile measuring device as claimed in claim 6,
characterized in that, by using the
supporting/measuring wheel (6), a track of the
path covered is recorded with the aid of the
computer unit (18).
- 35 8. The device as claimed in one or more of the
preceding claims, characterized in that the
satellite position measuring system is coupled
with sensors on the measuring wheel (6) and/or in
the measuring electronics (12), which extrapolate
the position information by generating a distance
vector in the computer unit (18).

9. The device as claimed in claim 8, characterized in that the direction component and/or the magnitude of the distance vector is/are generated via an electronic compass, an orthogonal pair of speed sensors, a two-axis orthogonal acceleration sensor or a gyroscope.
10. A method of monitoring gas lines, characterized in that a path predefined by an electronic navigation system is followed by means of a mobile measuring device.

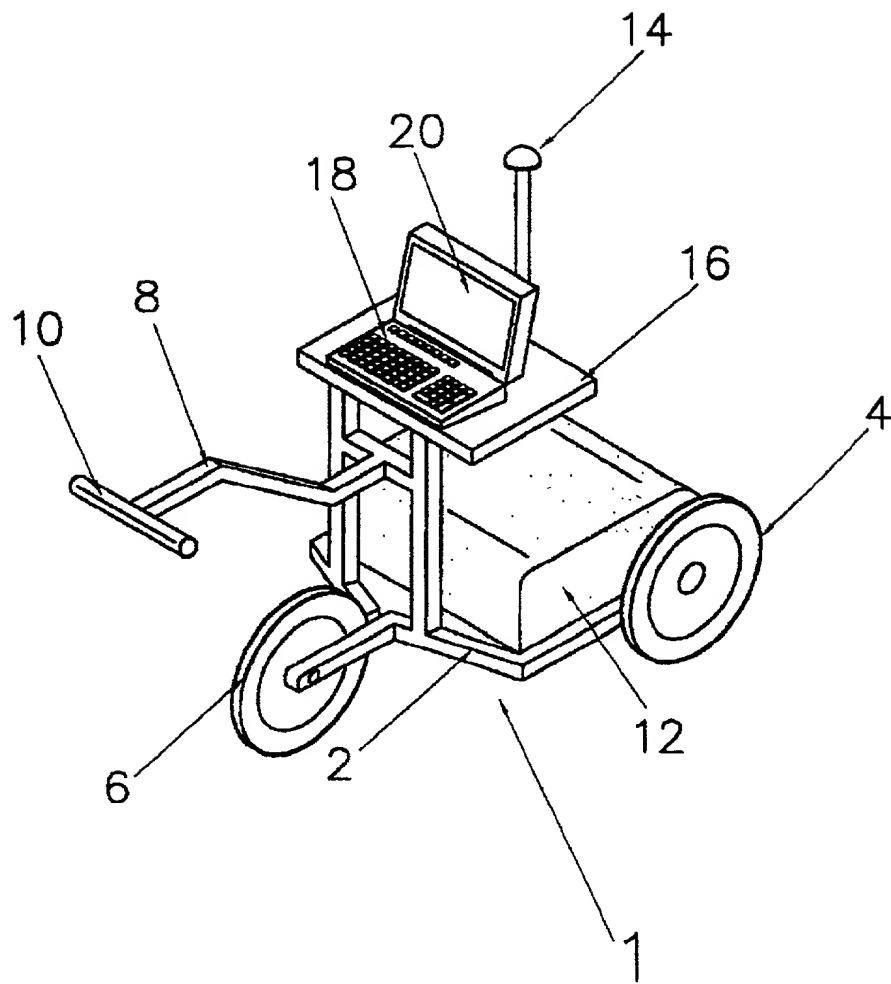


Fig. 1

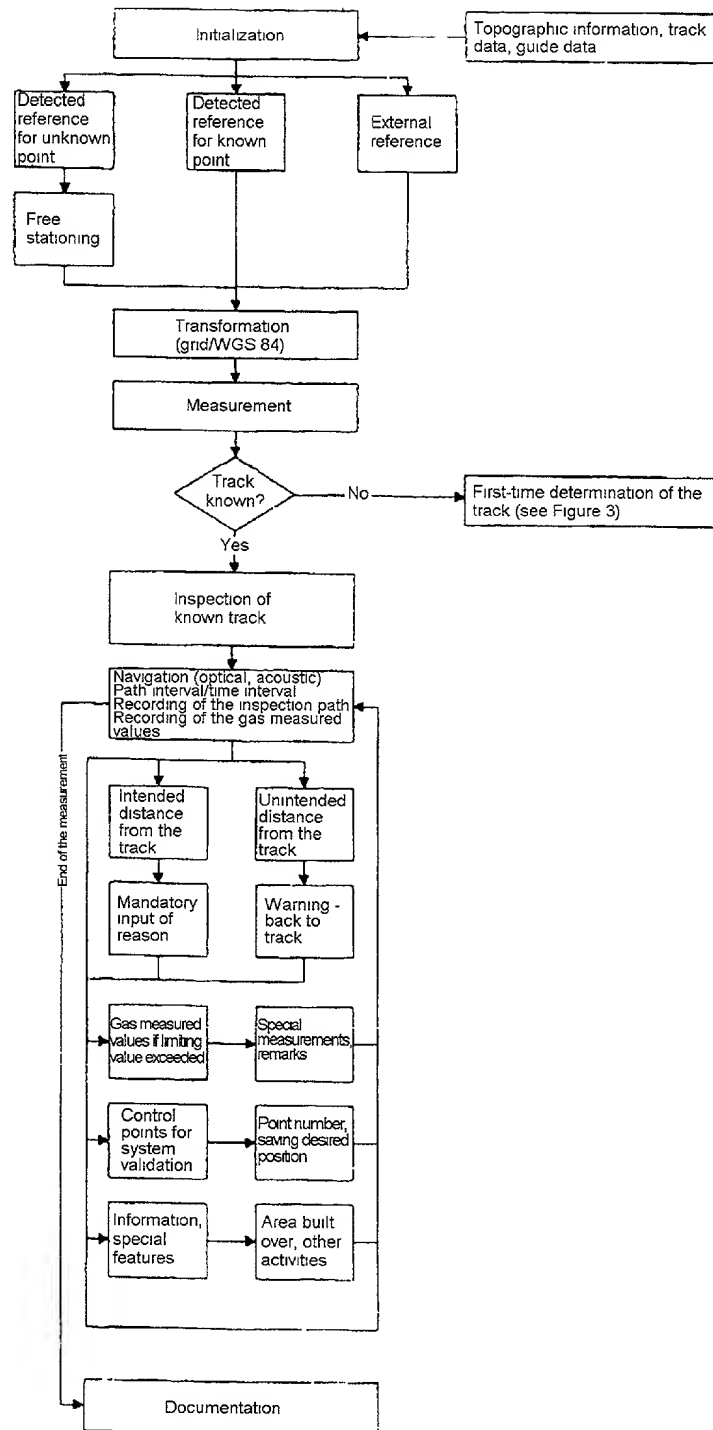


Fig. 2

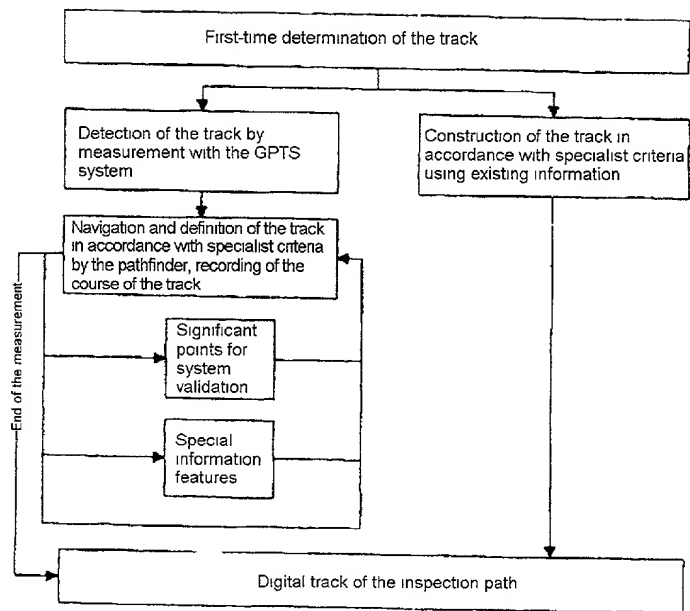


Fig. 3

PTO/SB/01 (03-01)

Approved for use through 10/31/2002. OMB 0651-0032
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**DECLARATION FOR UTILITY OR
DESIGN
PATENT APPLICATION
(37 CFR 1.63)**

☐ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number HOM 100

First Named Inventor Klaus Homann

COMPLETE IF KNOWN

Application Number /

Filing Date

Group Art Unit

Examiner Name

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

GEOREFERENCED MONITORING SYSTEM

(Title of the invention)

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International

Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
198 60 892.6	Germany	12/31/1998	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
199 07 995.1	Germany	02/25/1999	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

[Page 1 of 2]

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NAME OF SOLE OR FIRST INVENTOR:

☐ A petition has been filed for this unsigned inventor

Given Name

(first and middle (if any)) Klaus

Family Name

or Surname HomannInventor's
SignatureDate 22 JUN 2001Residence: City 44137 Dortmund

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ZIP

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Country

NAME OF SECOND INVENTOR:

☐ A petition has been filed for this unsigned inventor

Given Name

(first and middle (if any)) Burkhard

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or Surname KatzenbachInventor's
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Country☐ Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

(Page 2 of 2)